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Report for the Stage 3 in-depth review of emission inventories submitted under the UNECE LRTAP Convention and EU National Emissions Ceilings Directive for:

STAGE 3 REVIEW REPORT
LUXEMBOURG

CONTENT

INTRODUCTION

1. The mandate and overall objectives for the emission inventory review process under the LRTAP Convention is given by the UNECE document '*Methods and Procedures for the Technical Review of Air Pollutant Emission Inventories reported under the Convention and its Protocols'* [(1)] – hereafter referred to as the 'Methods and Procedures' document.

2. This annual review has concentrated on SO_2, NOx, NMVOC, NH_3, plus PM_{10} & $PM_{2.5}$ for the time series years 1990 – 2014 reflecting current priorities from the EMEP Steering Body and the Task Force on Emission Inventories and Projections (TFEIP). HMs and POPs have been reviewed to the extent possible.

3. This report covers the Stage 3 centralised reviews of the UNECE LRTAP Convention and EU NEC Directive inventories of Luxembourg, coordinated by the EMEP emission centre CEIP acting as review secretariat. The review took place from 20th June 2016 to 25th June 2016 in Copenhagen, Denmark, and was hosted by the European Environment Agency (EEA). The following team of nominated experts from the roster of experts performed the review: Generalist – Ieva Sile (Latvia), Energy – Dirk Wever (Netherlands), Transport – Yvonne Pang (UK), Industry – Mirela Poljanac (Croatia), Solvents – Ardi Link (Estonia), Agriculture + Nature – J Webb (UK), Waste – Katja Pazdernik (EC).

4. Kevin Hausmann was the lead reviewer. The review was coordinated by Katarina Marečková (EMEP Centre on Emission Inventories and Projections - CEIP).

[1] Methods and Procedures for the Technical Review of Air Pollutant Emission Inventories reported under the Convention and its Protocols. Note by the Task Force on Emission Inventories and Projections. ECE/EB.AIR/GE.1/2007/16 http://www.unece.org/env/documents/2007/eb/ge1/ece.eb.air.ge.1.2007.16.e.pdf

PART A: KEY REVIEW FINDINGS

5. Luxembourg submitted full time series of air pollutant emissions reported in the most recent format of NFR tables (NFR 2014-2), containing all pollutants; the UNECE notification form, as well as an Informative Inventory Report of high quality. In addition, projections (scenario "with additional measures") have been reported for the years 2020, 2025, and 2030.

6. Emission data was submitted with a delay; however, the final data and the IIR were submitted within the particular period set in the UNECE Reporting Guidelines.

7. The ERT notes that recalculations have been applied consistently and described for the full time series.

8. The 2016 submission includes improvements in a number of issues highlighted in the previous Stage 3 review. Nevertheless, the ERT identified a need for further improvements regarding transparency and QA/QC.

9. Luxembourg provided support to the ERT during the 2016 centralised stage 3 review, responding in a timely manner.

INVENTORY SUBMISSION

10. The inventory is generally in line with the EMEP/EEA emission inventory guidebook and UNECE Reporting Guidelines. In its 2016 submission, Luxembourg has provided a national inventory for the years 1990-2014 in NFR14 categories for all pollutants, except for those pollutants whose reporting is optional (BC, As, Cr, Cu, Ni, Se, Zn). For the following sectors emissions have been reported: 1A1-1A4, 1B2, 2C, 2D, 2H, 2I, 3B, 3D, 5C. No emissions have been reported in sectors 1B1, 2A, 2B, 2G-2L, 3F, 3I, 5A, 5B, 5D, 5E, 6A.

11. In addition, Luxembourg has provided national projections (scenario with additional measures) for 2020, 2025, and 2030 for the following pollutants: NOx, NMVOC, SOx, NH_3 and $PM_{2.5}$.

12. The ERT commends Luxembourg for the effort made to improve its inventory. Compared to the Stage 3 review in 2011, Luxembourg has provided full time series and covered more categories and pollutants, as well as a comprehensive Informative Inventory Report.

KEY CATEGORIES

13. In its 2016 IIR Luxembourg has compiled and presented a level and trend key category analysis for the following pollutants: NOx, NMVOC, SOx, NH_3, CO, TSP, PM_{10}, $PM_{2.5}$ both by fuel used and fuel sold. The ERT commends Luxembourg on its effort made since the 2011 Stage 3 review regarding the KCA. However, the ERT recommends that Luxembourg performs the KCA also for heavy metals and POPs and describes the results in the 2017 IIR.

14. The KCA shows that the energy sector dominates the emissions of SOx and CO, whereas the transport sector produces most NOx, TSP, PM_{10}, $PM_{2.5}$ emissions, while NMVOC emissions generally originate from solvents use and agriculture. For NH_3, agriculture is the only key category.

15. The KCA performed by Luxembourg is consistent with the EMEP/EEA emission inventory guidebook for all reported pollutants of 2014. The ERT commends Luxembourg on having Tier 2/3 methods and country/plant specific data for most of its key categories.

QUALITY

Transparency

16. The ERT commends Luxembourg on the substantial improvements made since the 2011 Stage 3 review.

17. Luxembourg uses the notation keys NE and IE in a few areas, but generally provides an explanation for particular notation keys by sub-sectors in its 2016 IIR.

18. The ERT commends Luxembourg on their very transparent IIR, especially the detailed comparison between emission totals from fuel sold and fuel used. The IIR generally follows the recommended structure of IIR (Annex II of the Reporting Guidelines). However, the ERT recommends that Luxembourg integrates the reports on persistent organic pollutants and heavy metals into the main parts of the IIR instead of leaving them as separate annexes.

19. The ERT commends Luxembourg on having made detailed improvements divided by sub-sectors and summarized in Chapter 8 of the 2016 IIR.

Completeness

20. The ERT commends Luxembourg on the great effort made to have an inventory for all pollutants whose reporting is mandatory, and encourages Luxembourg to also provide emissions for pollutants whose reporting is voluntary.

21. The ERT notes that activity data have not been provided for all sectors, therefore it is recommended that Luxembourg provides activity data for all sub-sectors where emissions occur.

Consistency, including recalculations and time-series

22. The ERT commends Luxembourg on having consistency checks on activity data and emissions.

23. The ERT commends Luxembourg on having made detailed recalculations divided by sub-sectors and summarized in Chapter 8 of the 2016 IIR.

Comparability

24. The ERT notes that while the energy sector mainly uses the EMEP/EEA 2009 Guidebook to calculate emission, the agriculture sector employs the EMEP/CORINAIR 2007 Guidebook. The ERT recommends that Luxembourg uses the latest version of the EMEP/EEA guidebook in all sectors to improve comparability.

25. The ERT notes that there are differences between the POPs emissions reported in NFR tables and those reported in the 2016 IIR POPs inventory. In answer to a question raised on this issue, Luxembourg stated that the NFR dataset should be considered as correct. Luxembourg explained that errors were corrected at a very late stage, and that the report had not been updated by the consultant in time for the IIR release. The ERT recommends that Luxembourg assures data consistency in future submissions.

CLRTAP/NECD comparability

26. For Luxembourg, there are no differences between emissions submitted under CLRTAP and NECD.

Accuracy and uncertainties

27. Luxembourg did not perform an uncertainty analysis. In response to a question raised by the ERT on this issue, Luxembourg stated that due to a lack of time and limited human resources it had not been possible to perform an uncertainty analysis, but that it was planned to do so in one of the next submissions. The plan was to first improve the uncertainty analysis of the GHG emission inventory, which uses a lot of the same activity data, and then determine the uncertainties for air pollutant emission factors. In the future, however, Luxembourg plans to implement an automated uncertainty analysis, which would make things much easier. The ERT recommends that Luxembourg progresses along these lines as quickly as possible.

Verification and quality assurance/quality control approaches

28. Luxembourg has described its QA/QC procedures in the IIR. However, the ERT recommends that Luxembourg compares the respective values reported in the IIR and the NFR tables for its next submissions, as there are differences between emissions reported and described in the 2016 IIR and the NFR tables.

FOLLOW-UP TO PREVIOUS REVIEWS

29. Luxembourg has significantly improved its inventory since the 2011 Stage 3 review. The ERT acknowledges that many recommendations have been taken into account, and commends Luxembourg on the great effort made to improve its inventory.

AREAS FOR IMPROVEMENTS IDENTIFIED BY LUXEMBOURG

30. According to information provided by Luxembourg

(a) It is planned to correct the calculation file with wrong links leading to increased emissions in sector 1A2b.

(b) It is planned to change notation keys from NO to IE in sector 1A2d.

(c) It is planned to re-evaluate emissions from mobile machinery, using the results of a new study.

(d) It is planned to improve the methodological description better reflecting the use of jet kerosene in 1A3a.

(e) It is planned to integrate the results of a study on the implementation of boiler technology in the commercial/institutional and residential categories (1A4a and 1A4b). Indeed, from about 2000 onwards, the use of new boilers with low NOx emissions (condensing oil and gas boilers) was accelerated in Luxembourg, and this low emission technology has not been considered in the air emission inventory.

(f) It is planned to integrate the results of a study on manure management systems (inventory) to closer reflect Luxemburg's specific situation an calculation of emissions from manure management (3B).

PART B: RECOMMENDATIONS FOR IMPROVEMENTS TO THE PARTY

CROSS-CUTTING IMPROVEMENTS IDENTIFIED BY THE ERT

31. The ERT has identified the following cross-cutting issues for improvement:

(a) The ERT recommends to perform KCA also for heavy metals and POPs and describe the results in the 2017 IIR.

(b) The ERT recommends to integrate the reports on persistent organic pollutants and heavy metals into the main parts of the IIR instead of leaving them as separate annexes.

(c) The ERT encourages Luxembourg to provide activity data for all sub-sectors where emissions occur.

(d) The ERT recommends that Luxembourg uses the latest version of the EMEP/EEA guidebook in all sectors to improve the comparability.

(e) The ERT recommends that Luxembourg implements the results of the uncertainty analysis in the next submissions.

(f) The ERT recommends that Luxembourg compares the values reported in the IIR and NFR tables for the next submissions as there are differences between emissions reported and described in the 2016 IIR and the corresponding NFR tables.

(g) The ERT recommends that Luxembourg reviews its use of the appropriate notation keys. In the NFR tables, “NO” is used in several cells, while in the same sub-sector emissions or other notation keys (mostly "NA") are reported as well. This is not in accordance with the Reporting Guidelines, which stipulate that “NO” should be used “for categories or processes within a particular source category that do not occur within a Party”. The ERT recommends that Luxembourg corrects these notation keys in line with the Reporting Guidelines. There are also a few zero values reported in NFR tables; the ERT suggests that Luxembourg uses an appropriate notation key in the next submission instead.

SECTOR SPECIFIC RECOMMENDATIONS FOR IMPROVEMENTS IDENTIFIED BY ERT

ENERGY

Review Scope

Pollutants Reviewed		All pollutants		
Years		1990 – 2014		
Code	**Name**	**Reviewed**	**Not Reviewed**	**Recommendation Provided**
1A1a	Public electricity and heat production	x		x
1A1b	Petroleum refining	NO		
1A1c	Manufacture of solid fuels and other energy industries	NO		
1A2a	Iron and steel	x		x
1A2b	Non-ferrous metals	x		x
1A2c	Chemicals	x		
1A2d	Pulp, Paper and Print	x		x
1A2e	Food processing, beverages and tobacco		x	
1A2f	Stationary combustion in manufacturing industries and construction: Non-metallic minerals	x		x
1A2gviii	Stationary combustion in manufacturing industries and construction: Other	x		x
1A3ei	Pipeline transport	NO		
1A3eii	Other	NO		
1A4ai	Commercial/institutional: Stationary	x		
1A4bi	Residential: Stationary	x		x
1A4ci	Agriculture/Forestry/Fishing: Stationary		x	
1A5a	Other stationary (including military)	NO		
1B1a	Fugitive emission from solid fuels: Coal mining and handling	x		x
1B1b	Fugitive emission from solid fuels: Solid fuel transformation	x		x
1B1c	Other fugitive emissions from solid fuels	x		x
1B2ai	Fugitive emissions oil: Exploration, production, transport	x		x
1B2aiv	Fugitive emissions oil: Refining / storage	x		x
1B2av	Distribution of oil products	x		x
1B2b	Fugitive emissions from natural gas (exploration, production, processing, transmission, storage, distribution and other)	x		x
1B2c	Venting and flaring (oil, gas, combined oil and gas)	x		x
1B2d	Other fugitive emissions from energy production	x		x

General recommendations on cross-cutting issues

Transparency

32. The ERT commends Luxembourg for submitting a complete IIR with source and method descriptions and references to data sources.

33. Luxembourg is now using the national energy balance as the basis for the activity data, which is also used for the GHG inventory. The ERT commends Luxembourg for this move towards more transparency.

Completeness

34. Luxembourg does not report any emissions for Black Carbon (BC) in the Energy sector. As BC is getting more and more important in modelling health issues, the ERT encourages Luxembourg to include the BC emissions in the inventory and report them in the next submission.

Consistency including recalculation and time series

35. The ERT considers the time series submitted by Luxembourg in the energy sector to be generally consistent.

Comparability

36. Luxembourg claims (IIR, page 124) that the default emission factors used are for the majority taken from the EMEP/EEA 2013 Guidebook, or an older version. However, looking at the EF tables for the different sub-sectors it seems that most emission factor were taken from the EMEP/EEA 2009 Guidebook or the 2010 revision, and no emission factors come from the EMEP/EEA 2013 Guidebook. The ERT recommends that Luxembourg applies the emission factors from the latest adopted version of the Guidebook in the next submissions.

Accuracy and uncertainties

37. In the 2011 review, the ERT encouraged Luxembourg to undertake an uncertainty analysis for the energy sector as soon as possible, in order to help support the improvement process and to provide an indication of the reliability of the inventory data. The ERT notes that in the 2016 submission no uncertainty analysis is provided for the energy sector. The ERT recommends that Luxembourg undertakes an uncertainty analysis in as soon as possible and reports on its results in next submissions.

38. In the 2011 review, the ERT recommended that Luxembourg sets up a QA/QC plan and implements QA/QC procedures. In the 2016 submission, Luxembourg describes a comprehensive QA/QC plan with a system of reviews and sector specific quality checks. The ERT commends Luxembourg for the progress made.

Improvement

39. The ERT notes that recalculations and planned improvements are now reported in the IIR.

Sub-Sector Specific Recommendations

Category issue 1: 1A1a – NOx

40. In answering a question from the ERT, Luxembourg mentioned using the emission factor from natural gas in reciprocating engines from the EMEP/EEA 2009 Guidebook for the combustion of biogas. This leads to an over- estimation of the emissions as this emission factor is lower - approximately by a factor of 10 -in the EMEP/EEA 2013 Guidebook. The ERT recommends that Luxembourg assesses the proper emission factor and implements it in the next submission, taking in account that engines running on biogas are perhaps not running as optimised as engines running on natural gas.

Category issue 2: 1A2a and 1A2b – All relevant pollutants

41. As in the 2011 submission, Luxembourg reports the emissions from the Industrial Sectors 2C1 (Iron and steel production), 2C2 (Ferroalloys production) and 2C3 (Aluminium production) in the Combustion Sectors 1A2a and 1A2b in this year's submission (2016). In the 2011 review, Luxembourg explained to the ERT that this had been done to avoid double counting as the emissions from these companies were based on measurements. The 2011 ERT recommended splitting the emissions based on the guidance of the EMEP/EEA 2013 Guidebook. The 2016 ERT reiterates its recommendation to split between combustion and process emissions based on the guidance from the EMEP/EEA 2013 Guidebook.

Category issue 3: 1A2d – All relevant pollutants

42. The ERT notes that in the IIR it is stated that "*before 1998 there are no activity data in the national statistics and that for that reason the notation key IE should be used in the NFR tables*". Presuming that indeed it can be concluded that it must be included somewhere else, this is the proper notation key to use. However, the ERT notes that in the IIR table 3-44 and also in the NFR tables 'NO' is still used. The ERT recommends that Luxembourg uses the correct notation key and corrects this in the next submission.

Category issue 4: 1A2f – Particulate matter

43. Luxembourg reports the emissions coming from cement production (2A1) under the combustion sector (1A2f). As particulate matter mostly originates from the process, the ERT recommends that Luxembourg reallocates these emissions to category 2A1 as recommended in the latest adopted version of the Guidebook.

Category issue 5: 1A2gviii – NMVOC and particulate matter

44. As in the 2011 submission, Luxembourg reports the emissions from the Industrial Sectors 2D2 (Road paving with asphalt) and 2D3 (Asphalt roofing) in the Combustion Sector 1A2gviii in its 2016 submission. In reply to the ERT in the 2011 review, Luxembourg stated that this had been done to avoid double counting as the emissions from these companies are based on measurements. The 2011 ERT recommended splitting the emissions based on the guidance of the EMEP/EEA 2013 Guidebook. The 2016 ERT reiterates its recommendation to reallocate these emissions to category 2D2, based on the guidance from the EMEP/EEA 2013 Guidebook.

Category issue 6: 1A4bi – All pollutants

45. The ERT notes that Luxembourg applies a Tier 1 approach for this sub-sector. However, residential stationary combustion is a key source. For this reason, it would be appropriate to apply a Tier 2 or Tier 3 approach. In response to a question about this, Luxembourg explained that a study on boiler technology installed in commercial and residential buildings had been conducted and would be used to switch to a Tier 2 method for the next submission.

Category issue 7: 1B1a, 1B1b, 1B1c, 1B2ai, 1B2aiv, 1B2c and 1B2d – Several pollutants

46. In the IIR it is stated that these sources do not exist in Luxembourg. However, the ERT notes that in the NFR tables (and in IIR table 3-167) for several pollutants the notation key NA is used. The ERT recommends that Luxembourg uses the notation keys consistently, in line with the IIR sector description and to correct this in the next submission.

Category issue 8: 1B2b – Several pollutants

47. During the 2011 review, the ERT recommended that Luxembourg, as a result of using both NO and NA for this sector, checks the consistency of the notation keys used. However, the 2016 ERT notes that in this year's submission 'NO' is still used for the priority HMs and POPs. The use of the notation key 'NO' means that the source/process does not exist. The ERT notes that this is not the case as emissions for NMVOC are reported. Therefore, 'NO' can never be used for this sector. Furthermore, in cases when activity data and a (default) emission factor are available one can never use NA, but has to use NE, however small the emissions are. The ERT reiterates its recommendation to check the consistency of the notation keys used.

Category issue 9: 1B2av and 1B2b – NMVOC

48. In chapter 3.3.2.2.2 of the IIR it is stated that a Tier 1 approach has been applied to calculate emissions from these sources. However, the ERT notes that the emission factors used are coming from the EMEP/EEA 2009 Guidebook and originate from the Tier 2 and Tier 3 tables. The ERT recommends that Luxembourg

uses the latest adopted version of the guidebook and to be consistent in the description of methodology in the IIR and the actual methodology used and to correct this in the next submission.

TRANSPORT

Review Scope

Pollutants Reviewed		All pollutants		
Years		1990 – 2014		
Code	**Name**	**Reviewed**	**Not Reviewed**	**Recommendation Provided**
1A2gvii	Mobile Combustion in manufacturing industries and construction	x		
1A3ai(i)	International aviation LTO (civil)	x		
1A3ai(ii)	International aviation cruise (civil)		x	
1A3aii(i)	Domestic aviation LTO (civil)	x		
1A3aii(ii)	Domestic aviation cruise (civil)		x	
1A3bi	Road transport: Passenger cars	x		x
1A3bii	Road transport: Light duty vehicles	x		x
1A3biii	Road transport: Heavy duty vehicles and buses	x		x
1A3biv	Road transport: Mopeds & motorcycles	x		x
1A3bv	Road transport: Gasoline evaporation	x		
1A3bvi	Road transport: Automobile tyre and brake wear	x		
1A3bvii	Road transport: Automobile road abrasion	x		
1A3c	Railways	x		
1A3di(ii)	International inland waterways	x		
1A3dii	National navigation (shipping)	x		x
1A4aii	Commercial/institutional: Mobile		NO	x
1A4bii	Residential: Household and gardening (mobile)		NO	x
1A4cii	Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	x		
1A4ciii	Agriculture/Forestry/Fishing: National fishing		NO	
1A5b	Other, Mobile (including military, land based and recreational boats)		NO	
1A3di(i)	International maritime navigation		NO	
1A3	Transport (fuel used)	x		

General recommendations on cross-cutting issues

Transparency

49. The ERT commends Luxembourg for submitting a detailed and transparent IIR for the transport sector. The calculation methods are well described with activity data and implied emission factors for the main pollutants being provided. The IIR also contains comparisons between fuel used and fuel sold results, which are useful. The ERT commends the effort put in by Luxembourg and the significant improvement made since the previous Stage 3 review.

50. During the review, the ERT asked Luxembourg to provide further information/clarification on:

(a) The methodology used to calculate cold start and evaporative emissions for 1A3b

(b) Sources of metals and POPs EFs used for 1A3b

(c) Different NMVOC and NH3 emissions trends for 1A3d

The ERT thanks Luxembourg for providing the requested information and encourages the Party to include this information in future IIRs.

51. The ERT has noted some irregularities in the emission trends of heavy metals and POPs for 1A3b. Luxembourg confirmed that they are errors in the calculation formulas (except for PAH - see the next bullet point) and intends to update their QA/QC procedures so to avoid such errors in future submissions. The ERT encourages Luxembourg to carry out the intended plan and provide correct estimates for the next submission.

52. For PAH (as mentioned above), the ERT has noted a step change in the PAH IEFs for 1A3b from 2012 onwards. Luxembourg clarified that Tier 2 factors from the 2013 EMEP/EEA Emissions Guidebook were used from 2012 onwards (while the previous version of the Guidebook was used for the other years). The ERT recommends that Luxembourg uses the updated Tier 2 factors from the 2013 Guidebook and applies them across the time series. Luxembourg confirmed its intention to do so for the next submission.

Completeness

53. The ERT considers the transport inventory nearly complete for the main pollutants. However, the ERT has noted that emissions have not been estimated for the following sources and pollutants:

(a) Heavy metal and PAHs emissions from 1A2gvii, 1A3c,

(b) PCDD/ PCDF, HCB and PCB emissions from 1A3d

(c) NH_3 , heavy metal and PAHs emissions from 1A4cii

54. During the review, Luxembourg indicated its intention to provide emission estimates for the aforementioned sources in the next submission. The ERT encourages Luxembourg to carry out this improvement.

Consistency including recalculation and time series

55. The ERT considers the transport inventory to be generally consistent across the time series. However, the ERT has noted that detailed calculations using the Network Emission Model (NEMO)[2] were made for the time-series of road transport

[2] The Network Emission Model (NEMO) is a tool developed by the Institute for Internal Combustion Engines and Thermodynamics (IVT) at the Graz University of Technology (TUG) for the simulation of traffic related emissions in road networks.

emissions between 1990 and 2013, while a less detailed method with the aid of projection information was used to determine emission estimates for 2014. The IIR indicates that Luxembourg is planning to re-conduct a detailed calculation every few years in order to replace the projected data. The ERT recommends that Luxembourg carries out the improvement plan to ensure that a consistent methodology is applied across the time series in future submission.

56. The IIR includes brief explanations for the reasons why recalculations were made for the transport sector. The ERT encourages Luxembourg to provide more detailed explanations for recalculations including the rationale, impact on the sector and emission trends, in particular when the impact varies by pollutants.

57. The ERT noted that incorrect notation keys (NO) were used for PM emissions from 1A3bvi and 1A3bvii, and Luxembourg confirmed that emissions for these categories were included in NFR 1A3bi-iv. Luxembourg indicated its intentions to report PM emission estimates for these categories separately in the next submission. The ERT recommends that Luxembourg carries out this improvement plan.

Comparability

58. The ERT considers the methods used by Luxembourg to estimate emissions of pollutants from transport sources to be consistent with those proposed in the Guidebook. For road transport (1A3b), Luxembourg uses the Network Emission Model and the IIR has provided good levels of detail in the methodology descriptions.

59. The ERT encourages Luxembourg to provide more information in future IIRs regarding its country specific off-road vehicles model (the GEORG - *Grazer Emissions modell für Off-Road Geräte* as developed by the TU Graz), for instance, the categories of engine types that are being considered and the origin of country-specific emission factors used in this model.

Accuracy and uncertainties

60. The IIR indicates that no uncertainty estimates were made for the transport sector. However, uncertainty of the activity data can be found in Luxembourg's National Inventory Report (NIR). For road transport (1A3b), descriptions have been provided for the parameters that are considered to have relatively high uncertainties. The ERT encourages Luxembourg to undertake an uncertainty analysis for the transport sector and to use the results to prioritise further improvements.

61. The IIR indicates that consistency and completeness checks are performed as part of the QAQC procedures for the transport sector. During the review, the ERT identified a few errors (e.g. inconsistent $PM_{2.5}/PM_{10}$ emission trends for 1A3d, description of KCA for 1A2gvii did not match the KCA result table). The ERT thanks Luxembourg for its prompt action to correct these mistakes and for its intention to update the QA/QC procedures to avoid these errors in future.

Improvement

62. The ERT notes Luxembourg's intention to improve time series' consistency for 1A3b and to explore the suitability of integrating the results of a country-specific study on off-road mobile machinery for 1A3c and 1A3d. The ERT encourages Luxembourg to carry out this improvement plan.

Sub-sector Specific Recommendations

Category issue 1: All Transport - TSP/PM_{10}/$PM_{2.5}$

63. During the review, the ERT identified consistency issues associated with PM emissions from 1A3b and 1A3d, whereby $PM_{2.5}$ > PM_{10} > TSP or they show inconsistent trends. The ERT recommends that Luxembourg includes consistency checks for PM trends and TSP>= PM_{10} >= $PM_{2.5}$ checks for all transport sources as part of its QA/QC procedures for future submissions.

Category issue 2: 1A3d - All Pollutants

64. The IIR shows that Luxembourg has used Tier 1 emission factors from the 2009 version of the Guidebook for its emission calculations for 1A3d. However, the ERT has noted that the magnitude of gas oil EFs is not correct and values for diesel/gasoline EFs are not consistent with the Tier 1 EFs from the 2009 version of the Guidebook. The ERT asked Luxembourg to check whether correct EFs were used for 1A3d calculations. During the review, Luxembourg confirmed that correct EFs were used in the calculations but not presented correctly in the IIR. Luxembourg indicated its intention to switch to the use of Tier 1 EFs from the 2013 Guidebook for its next submission. The ERT encourages Luxembourg to carry out this improvement by using the latest adopted version of the Guidebook.

Category issue 3: 1A4aii, 1A4bii - All Pollutants

65. The notation key 'NO' is currently used for these categories. During the review, the ERT asked Luxembourg to clarify whether activity data are expected from these sources. Luxembourg stated that the national energy statistics did not provide fuel consumption data for these categories (except for 1998-2000 for 1A4bii), and that, to tackle this problem, Luxembourg would explore the use of its off-road vehicles model to see whether bottom up estimates could be made. The ERT encourages Luxembourg to carry out this improvement plan and suggests that the notation key NE should be used as some emissions/activity is expected from these categories.

INDUSTRIAL PROCESSES

Review Scope

Pollutants Reviewed		All pollutants		
Years		1990 – 2014		
Code	**Name**	**Reviewed**	**Not Reviewed**	**Recommendation Provided**
2A1	Cement production	x		x
2A2	Lime production		NO	
2A3	Glass production	x		x
2A5a	Quarrying and mining of minerals other than coal	x		x
2A5b	Construction and demolition	x		x
2A5c	Storage, handling and transport of mineral products	x		x
2A6	Other mineral products	x		x
2B1	Ammonia production		NO	
2B2	Nitric acid production		NO	
2B3	Adipic acid production		NO	
2B5	Carbide production		NO	
2B6	Titanium dioxide production		NO	
2B7	Soda ash production		NO	
2B10a	Chemical industry: Other		NO	
2B10b	Storage, handling and transport of chemical products		NO	
2C1	Iron and steel production	x		x
2C2	Ferroalloys production	x		x
2C3	Aluminium production	x		x
2C4	Magnesium production		NO	
2C5	Lead production		NO	
2C6	Zinc production		NO	
2C7a	Copper production	x		x
2C7b	Nickel production		NO	
2C7c	Other metal production	x		x
2C7d	Storage, handling and transport of metal products	x		x
2D3b	Road paving with asphalt	x		x
2D3c	Asphalt roofing	x		x
2H1	Pulp and paper industry		NO	
2H2	Food and beverages industry	x		x
2H3	Other industrial processes	x		x
2I	Wood processing		NO	
2J	Production of POPs		NO	
2K	Consumption of POPs and heavy metals (e.g. electrical and scientific equipment)	x		x
2L	Other production, consumption, storage, transportation or handling of bulk products		NO	

General recommendations on cross-cutting issues

66. Luxembourg has submitted an IIR and NFR tables for the whole time series. However, the submitted NFR tables only contain emissions for priority heavy metals and POPs for category NFR 2.C.1 "Iron and steel production" while for all other

source categories in sector NFR 2 Industrial processes Luxembourg uses notation keys. Related recommendations can be found in the following sections.

Transparency

67. The ERT finds that Luxembourg's IIR and NFR tables for the industrial sector are of limited transparency. Luxembourg states in the IIR that for the industrial sector activity data and relevant parameters stem from national statistics, plant specific data and specific questionnaire / survey / annual reports. However the NFR tables do not contain any activity data for the source categories in the scope of NFR 2. In many categories the notation key 'IE' is used and the information contained in the IIR is not detailed enough and not described in a way that would enable reviewers to fully assess underlying assumptions and the rationale for selection of data, methods and other inventory parameters. There are no trend descriptions for the industrial sector in the IIR.

68. The use of the notation keys is not appropriate for all source categories (see sub-sector recommendations below). In addition, the notation keys used in the NFR and IIR should be the same to ensure transparency, but they are not the same for all source categories. The ERT recommends that Luxembourg updates the information accordingly for the next submission in 2017.

Completeness

69. The ERT notes that in the NFR tables the notation keys 'IE' and 'NA' have been widely used for the industrial sector. Therefore, the ERT finds that the NFR tables are not complete. The ERT strongly recommends splitting emissions according to the EMEP/EEA Guidebook for the next submission in 2017. Additional details and specific recommendations are provided in the sub-sector section below.

Consistency including recalculation and time series

70. Luxembourg does not provide activity data and emission trends in the IIR and NFR tables. The ERT strongly recommends that Luxembourg includes and explains trends and activity data in both the reporting tables and the report of the next submission in 2017.

Comparability

71. The ERT notes that the methods used by Luxembourg are not always consistent with those proposed in the EMEP/EEA guidebook. The ERT recommends that Luxembourg applies the methods provided in the EMEP/EEA guidebook for industrial processes and provides full NFR tables with a minimum use of notation keys to ensure comparability with those of other reporting parties.

Accuracy and uncertainties

72. The ERT notes that no uncertainty analysis has been performed by Luxembourg for the industrial sector. The ERT encourages Luxembourg to undertake

an uncertainty analysis for the industrial sector in order to prioritize improvement activities and to provide an indication of the reliability of the inventory data.

73. The ERT notes that according to the IIR, Luxembourg has not implemented any specific sectoral QA/QC checks for the industrial sector. During the review week, Luxembourg clarified that emissions from the industry sector were mostly allocated to the energy sector, due to the fact that plant-specific measurement data was reported, which cannot be separated into energy and process specific emissions, as emissions are measured in the stacks. The QA/QC specific procedures followed in the industry sector are described in para. 4.1.1.4 on p. 296 of the IIR. The ERT commends Luxembourg for the clarification provided and encourages Luxembourg to improve and upgrade the QA/QC system with source-specific elements of QA/QC for the industrial sector.

Improvement

74. The ERT notes that according to the IIR and Luxembourg's response to a related question, Luxembourg does not plan any further improvements for the industrial processes and product use sector.

Sub-sector Specific Recommendations

Category issue 1: 2 Industrial processes

75. The ERT notes that Luxembourg does not use notation keys for emissions of BC and all additional heavy metals in the NFR tables and recommends that Luxembourg includes appropriate notation keys in the NFR tables for emissions of BC and all additional heavy metals and for all NFR codes in the scope of the industrial sector for the next submission.

Category issue 2: 2A1 Cement production

76. During the review, the ERT noted a possible underestimation of PM10, PM2.5, BC and TSP emissions from 2.A.1 (IE in 1.A.2.f). Luxembourg provided an explanation for that issue and the ERT accepted it, recommending that Luxembourg includes that explanation in the IIR for the next submission. The ERT also recommends that Luxembourg follows the EMEP/EEA guidebook and reports all emissions of PM_{10}, $PM_{2.5}$, TSP and BC in the source category 2.A.1, because those emissions are mainly emitted from raw material and product handling, milling, cooling and while all other emissions of NOx, CO, NMVOC, SOx, heavy metals and POPs can be assumed to be mainly due to the combustion of solid and waste fuels and should be included in source category 1.A.2.f.

Category issue 3: 2A3 Glass production

77. During the review, the ERT noted the wrong allocation of TSP, PM_{10} and $PM_{2.5}$ for glass production in the NFR tables. The ERT recommends that Luxembourg reports emissions according to the EMEP/EEA guidebook for the next submission in the 2017. The ERT wants to highlight that reallocation of emissions

does not mean changing the methodology from Tier 3 to Tier 1. Instead, the ERT suggests that Luxembourg allocates emissions of TSP, PM10, PM2.5 and heavy metals from the energy sector (1.A.2.f) to 2.A.3.

Category issue 4: 2A5a Quarrying and mining of minerals other than coal

78. During the review, the ERT tried to clarify whether there is quarrying and mining of minerals other than coal in Luxembourg and if so, asked Luxembourg to collect data on production statistics (available from national statistical yearbooks) and to calculate emissions of PM_{10}, $PM_{2.5}$, and TSP using the Tier 1 methodology for the next submission. Luxembourg stated that the mine used by the clinker production facility (in Rumelange) is situated in France (in Ottange) just on the other side of the border. Raw materials are transported via covered conveyor belts (length approx. 1km) to Rumelange. Hence, the use of NO seems justified. The ERT commends Luxembourg for providing detailed information and clarification on this issue and recommends that Luxembourg includes this kind of information in the IIR to ensure completeness and transparency.

Category issue 5: 2.A.5.b Construction and demolition

79. The ERT notes that Luxembourg uses the notation key 'NA' for 2.A.5.b Construction and demolition instead of 'NE' for emissions of PM_{10}, $PM_{2.5}$, TSP and suggested to Luxembourg to collect data on total annual statistics on floor area of buildings constructed or demolished per year (available from national statistics) and to calculate emissions of PM10, PM2.5, TSP using the Tier 1 methodology for the next submission. Luxembourg confirmed that they would change the notation key to 'NE' in its next submission, and start collecting data on floor area of buildings constructed or demolished per year and calculate emissions of PM_{10}, $PM_{2.5}$, TSP using the revised Tier 1 methodology as proposed in the EMEP/EEA 2016 Guidebook, in one of its next submissions.

Category issue 6: 2C Metal production

80. The ERT asked Luxembourg to provide information on production activities in the scope of 2.C Metal production for the full historical trend, since there is no information on that in chapter 4 "Industrial processes and other product use" (IPPU) of the IIR. Luxembourg responded that for 2.C.1, all emissions were reported under 1.A.2.a, including TSP, PM_{10} and $PM_{2.5}$ process emissions and referred to the NIR 2016 for production data. The ERT recommends that Luxembourg reallocates emissions of TSP, PM_{10} and $PM_{2.5}$ from 1.A.2.a to 2.C.1 and includes activity data in the NFR tables.

Category issue 7: 2D3b Road paving with asphalt

81. The ERT found that Luxembourg uses the notation key 'IE' for emissions of NMVOC, TSP, PM_{10} , $PM_{2.5}$, and BC from road paving with asphalt in its NFR tables and asked for an explanation. Luxembourg responded that emissions were included in 1A2gviii, and that those were calculated based on asphalt production data. In

addition, Luxembourg saw the need to reallocate those emissions from 1.A.2.g.viii to 2.D.3.b, which meant that the notation keys for combustion emissions needed to be changed accordingly. The ERT commends Luxembourg on the response and recommends that Luxembourg carries out these changes as stated for the next submission in 2017.

Category issue 8: 2D3c Asphalt roofing

82. The ERT found that Luxembourg uses the notation key 'IE' for emissions of CO, NMVOC, TSP, PM_{10} and $PM_{2.5}$ from asphalt roofing and asked Luxembourg for the rationale behind using notation key 'IE' for asphalt roofing and suggested to collect data on the production of shingles per year and to calculate all relevant emissions (CO, NMVOC, TSP, PM_{10}, $PM_{2.5}$, BC) for the next submission. Luxembourg replied that there was no shingles production in Luxembourg, and that asphalt roofing did not occur and that the use of notation key 'IE' was wrong, and that it should be 'NO'. The ERT commends Luxembourg on this clarification and recommends that Luxembourg corrects this in the NFR tables and the IIR for the next submission in 2017.

Category issue 9: 2H2 Food and beverages industry

83. The ERT found that Luxembourg uses the notation key NA for the food and beverages industry in NFR tables and asked for an explanation. Luxembourg explained that notation keys needed to be revised for this source category and that NMVOC emissions needed to be estimated for beer, wine, bread productions, etc., or reported as 'NE'. In addition, Luxembourg stated that PM_{10} emissions from the handling of agricultural products in the food industry might need to be reported as 'NE', as it would be difficult to estimate these emissions due to a lack of data. The ERT commends Luxembourg for the provided response, and recommends that Luxembourg follows up on these issues in the next submissions.

Category issue 10: 2H3 Other industrial production

84. The ERT notes that Luxembourg uses the notation key IE for 2.H.3 in its NFR tables and that there is no information about where these emissions are included in the IIR. Luxembourg explained that the notation key should read 'NA' in the NFR or 'NO', because in Luxembourg no emissions for this category occur. The ERT commends Luxembourg on that clarification, and recommends that Luxembourg includes this information in the next IIR 2017.

Category issue 11: 2I Wood processing

85. The ERT has noted that Luxembourg uses different notation keys in the IIR and in the NFR tables for wood processing activities. Luxembourg explained that the NFR tables should read 'IE' and that this would be corrected in the next submission.

Category issue 12: 2.K Consumption of POPs and heavy metals

86. The ERT notes that for activities under the NFR code 2K, activity data for the Tier 1 approach for calculating emissions of Hg and PCB, according to EMEP/EEA 2013 Guidebook, is the country's total population. The ERT asked Luxembourg to explain why they did not calculate Hg and PCB emissions and whether this could be done for the next submission. Luxembourg responded that these emissions had not been estimated yet and should have been reported as 'NE'. Luxembourg mentioned that these emissions were very low and using the Tier 1 methodology as proposed in the guidebook would certainly lead to overestimating these emissions due to PCB containing electrical equipment being almost completely phased out. While the ERT agrees with this assessment for 2014, it does not apply for the full historical trend since 1990. The ERT recommends that Luxembourg revises its conclusion and reports PCB emissions in the historical time series. Luxembourg mentioned that a specific database in which all PCB containing equipment is registered could be a source of more reliable data. The ERT agrees with that view and encourages Luxembourg to collect data and report PCB emissions for NFR 2.K in one of the next submissions.

87. Besides PCB emissions, this category is also a potential source of Hg emissions that can arise from the use of batteries, measuring and control equipment (including laboratory and hospital equipment), electrical equipment and lighting. The ERT recommends that Luxemburg considers options available to report Hg emissions for the next submission in 2017.

SOLVENTS

Review Scope

Pollutants Reviewed		NMVOC		
Years		1990 – 2014		
Code	**Name**	**Reviewed**	**Not Reviewed**	**Recommendation Provided**
2D3a	Domestic solvent use including fungicides	x		x
2D3d	Coating applications	x		x
2D3e	Degreasing	x		
2D3f	Dry cleaning	x		
2D3g	Chemical products	x		
2D3h	Printing	x		
2D3i	Other solvent use	x		
2G	Other product use	NO		x

General recommendations on cross-cutting issues

Transparency

88. Luxembourg provides the description of the Austrian methodology used for NMVOC emission calculations as suggested by the ERT in the previous review and for that, the ERT commends Luxembourg.

89. The ERT considers Luxembourg's methodology and emission factors in the IIR to be generally transparent and well described for the solvent sector.

90. The ERT encourages Luxembourg to describe the reasons behind the emission trends in the next submissions of its IIR to improve transparency.

91. In order to improve the transparency of inventories even more, the ERT encourages Luxembourg to mention in the IIR, whether activities with corresponding pollutant emission factors that are covered in the EMEP/EEA Guidebook, occur in the country, but emissions are not estimated or whether they do not occur at all.

92. For even more transparency, the ERT recommends that Luxembourg includes exact information on what kind of activity data is used for emission calculations by every activity that is covered in the solvent sector in the IIR.

93. In tables 4-8 of the 2016 IIR Luxembourg presents activities by SNAP code that are taken into account in the inventory. The ERT suggests that, if there are activities that are included under some other activity, to point that fact out in the IIR in the next submission.

Completeness

94. The ERT considers the solvent sector generally to be complete and comprehensive with good levels of detail in the methodology descriptions for key sources.

95. However, the ERT notes that Luxembourg's inventory does not cover activities and pollutant emissions from the NFR 2.G Other product use sector, like the use of shoes, fireworks and tobacco. The ERT encourages Luxembourg to investigate if it is possible to include these activities in the inventory.

Consistency including recalculation and time series

96. The ERT considers the time series of the solvent sector to be generally consistent, but encourages Luxembourg to include the description of emission trends in the IIR in the next submission.

97. The ERT notes that according to the IIR, Luxembourg has done emission recalculations compared to the previous submission, but encourages the Party to include a more detailed explanation of the impact on the sector and implications on trends for the solvent sector in its IIR.

Comparability

98. The ERT notes that the combination of bottom-up and top-down approaches is the best way to get a comprehensive and complete inventory and the ERT commends Luxembourg for using that kind of methodology.

99. The ERT notes that the inventory of Luxembourg is comparable with those of other reporting parties.

Accuracy and uncertainties

100. The ERT notes that no uncertainty analysis has been performed by Luxembourg for the solvent sector nor concerning the CLRTAP emissions. The ERT encourages Luxembourg to undertake an uncertainty analysis for the solvent sector in order to prioritize improvement activities and to provide an indication of the reliability of the inventory data.

101. The ERT notes that according to IIR, Luxembourg performs comprehensive sectoral QA/QC checks and the ERT commends Luxembourg for that.

Improvement

102. The ERT notes that according to the IIR, Luxembourg does not plan any further improvements for the solvents sector.

103. Since the last pillar year is 2010, the ERT encourages Luxembourg to set a new pillar year for 2015 for the verification and adjustment of the solvents sector data to keep the methodology used in the inventory as up-to-date as possible.

Sub-sector Specific Recommendations

Category issue 1: 2D3a Domestic solvent use including fungicides – NMVOC

104. The ERT recommends that Luxembourg includes the description of how emissions are calculated for domestic solvent use for better transparency, because the current IIR 2016 only mentions that this sector is analysed separately, but there is no information on how this is done.

Category issue 2: 2D3d Coating application – NMVOC

105. The ERT notes that at the moment it is not clear if Luxembourg distinguishes between solvent- and water-borne paints using appropriate emission factors to demonstrate whether the EU's Solvents and DecoPaint Directives have had any impact on NMVOC emissions from coating application or not. The ERT also notes that the implied emission factor for this sector has gone up since 2005 and has stayed steady since 2010. For better transparency, the ERT recommends that Luxembourg includes an analysis of this trend in the IIR.

Category issue 3: 2G Other product use – All

106. The ERT notes that Luxembourg reports the notation key 'NO' ('Not Occurring') under NFR 2.G. During the review, Luxembourg explained to the ERT that the correct notation key under that sector would be 'NE' ('Not Estimated'). The Party also explained that collecting corresponding activity data had proven to be difficult, but it was working on resolving this issue and planned to submit the related data in a future submission. The ERT recommends that Luxembourg uses the correct notation key in the inventory and also commends the Party for trying to include the emissions from the use of shoes, tobacco and fireworks in a future submission.

AGRICULTURE

Review Scope

Pollutants Reviewed		NOx, NH3, NMVOC, PM		
Years		1990 – 2014		
Code	**Name**	**Reviewed**	**Not Reviewed**	**Recommendation Provided**
3B1a	Dairy cattle	x		x
3B1b	Non-dairy cattle	x		
3B2	Sheep	x		
3B3	Swine	x		
3B4a	Buffalo	NO		
3B4d	Goats	x		
3B4e	Horses	x		
3B4f	Mules and asses	IE		
3B4gi	Laying hens	x		
3B4gii	Broilers	x		
3B4giii	Turkeys	IE		
3B4giv	Other poultry	x		
3B4h	Other animals	x		
3Da1	Inorganic N-fertilizers (includes also urea application)	x		x
3Da2a	Animal manure applied to soils	IE		x
3Da2b	Sewage sludge applied to soils	NO		
3Da2c	Other organic fertilisers applied to soils (including compost)	NO		
3Da3	Urine and dung deposited by grazing animals	x		
3Da4	Crop residues applied to soils	NO		
3Db	Indirect emissions from managed soils	NO		
3Dc	Farm-level agricultural operations including storage, handling and transport of agricultural products	NO		
3Dd	Off-farm storage, handling and transport of bulk agricultural products	NO		
3De	Cultivated crops	x		
3Df	Use of pesticides	NE		
3F	Field burning of agricultural residues	NO		
3I	Agriculture other	NO		
11A	Volcanoes	NO		
11B	Forest fires	NO		

General recommendations on cross-cutting issues

Transparency

107. Luxembourg has provided a generally transparent emission inventory for the agriculture sector. The ERT makes sub-sector specific (3Da1 and 3Da3) recommendations to further improve transparency.

Completeness

108. NOx and NMVOC emissions have now been reported for the agriculture sector. There do not appear to be any omissions although the ERT recommends that for future inventories emissions following application of livestock manure are estimated using the new method described in the 2016 Guidebook revision and that these emissions are reported under 3Da2a.

Consistency including recalculation and time series

109. Trends are reported in the inventory submission and consistency and completeness checks have been made. Recalculations have been carried out.

Comparability

110. According to the information provided there are no differences between the LRTAP and NECD submissions.

Accuracy and uncertainties

111. The ERT encourages Luxembourg to implement the planned uncertainty analysis be carried out for the agriculture sector and for other sectors as well.

112. While checking the calculations provided for the adjustment review, the ERT could not confirm some emission calculations (NOx for 3B). These issues are addressed in detail in the sub-sector specific recommendations.

Improvement

113. The ERT has noted that no uncertainty analysis was carried out for the agriculture sector and recommends this be done in future. Luxembourg replied that while it had not yet made any uncertainty assessment for the air pollutant emission inventory this was a planned improvement. Depending on the availability of resources an uncertainty assessment for the main pollutants would be done in one of the next submissions. The ERT thanks Luxembourg for the reply and encourages the Party to introduce an uncertainty analysis at the earliest opportunity.

Sub-sector Specific Recommendations

Category issue 1: 3B Manure Management

114. Emissions are reported for each year in the IIR together with livestock numbers, making reporting transparent. However, while checking the adjustment emissions the ERT was unable to verify the calculation of NOx for the 3B sub-categories. This issue was discussed with Luxembourg as part of the adjustment review.

Category issue 2: 3B1a Dairy cattle

115. Cattle (3B1) are a key source for NMVOC emissions and since there is a Tier 2 method for this in the Guidebook a Tier 2 methodology should be used to calculate NMVOC emissions from this source. However, section 5.3.2 of the IIR 2016 indicates that these emissions were calculated using Tier 1. The ERT asked the Party if there were plans to use the Tier 2 approach in future. Luxembourg replied that calculation of emissions from the Agricultural Sector had been completely revised for this submission, using the latest available data and methods. As a result of this revision the Party reported NMVOC emissions from this category for the first time, thereby increasing the completeness of the inventory. For this first estimate the Party decided to use the Tier 1 method. Subsequently, the category was revealed to be a key category, and hence a Tier 2 method should have been used. However, this would have required more data collection and the development of new calculation routines, which was not possible for this submission. Using a Tier 2 method will be taken up into the improvement plan, and the availability of the necessary data will be investigated. Depending on the results, a Tier 2 method might then be implemented in one of the future submissions.

116. The ERT thanks Luxembourg for this response and encourages them to obtain the data in order to calculate emissions using a Tier 2 approach in future.

Category issue 3: 3D Agricultural Soils– Ammonia

117. The ERT noted that a 29% reduction in NH3 emissions since 1990 was reported in the IIR for 3D. The ERT informed the Party that it would be useful to report in the IIR the reason for this decrease, which the ERT inferred was largely due to a decrease in N fertilizer use. The Party confirmed that the inference of the ERT was correct. The Party pointed out that the emissions reported under category 3D was composed of emissions from 3Da1-Inorganic fertilizer use (85%) and 3Da3-Urine and dung deposited by grazing animals (15%). The ERT thanked the Party for confirming this. The ERT noted that reporting emissions from each sub-sector of the IIR would increase the transparency of the submission.

Category issue 4: 3Da1 Inorganic N-fertilizers

118. The ERT pointed out to the Party that a Tier 1 method was used to calculate NH_3 emissions following N fertilizer application (5.3.3.1.1). Since this is a key category, a Tier 2 approach should have been used. The Party replied that this was a planned improvement (described in section 5.3.7 on p.321 of the IIR). However, it was not certain if the data needed for a Tier 2 method (e.g. amounts of different types of inorganic fertilizers used, soil pH) was available in Luxembourg. Hence, this improvement should be considered a long term improvement. The ERT thanked the Party for their reply and encouraged them to try to obtain the information needed to adopt a Tier 2 approach for this key category.

WASTE

Review Scope

Pollutants Reviewed		All pollutants		
Years		1990 – 2014		
Code	**Name**	**Reviewed**	**Not Reviewed**	**Recommendation Provided**
5A	Solid waste disposal on land	x		x
5B1	Biological treatment of waste - Composting	x		x
5B2	Biological treatment of waste - Anaerobic digestion at biogas facilities		x	
5C1a	Municipal waste incineration	x		x
5C1bi	Industrial waste incineration	x		x
5C1bii	Hazardous waste incineration	x		x
5C1biii	Clinical waste incineration	x		x
5C1biv	Sewage sludge incineration	x		x
5C1bv	Cremation	x		x
5C1bvi	Other waste incineration		x	
5C2	Open burning of waste	x		x
5D1	Domestic wastewater handling	x		x
5D2	Industrial wastewater handling	x		x
5D3	Other wastewater handling		x	
5E	Other waste	x		x

General recommendations on cross-cutting issues

119. The submission of Luxembourg under CLRTAP regarding waste is not complete. A considerable number of sources and pollutants are not estimated but reported as "NA" and "NO", although related activities do occur in Luxembourg and default emission factors are provided by the EMEP/EEA Guidebook. However, improvements were made since the previous Stage 3 review. A chapter on waste was provided and emission data for clinical waste incineration and cremation were submitted. Recommendations and encouragements were given to improve completeness and transparency of reporting.

Transparency

120. The sectoral chapter in Luxembourg's IIR provides an overview of the reporting status for the main pollutants and PM per subcategory. However, justifications for the use of the notation keys are to a large extent missing. The ERT recommends that Luxembourg improves the transparency of reporting by providing explanations regarding the use of the notation keys or provides estimates in its next submission.

121. A study on POPs emissions was conducted, also covering emissions from waste incineration (clinical waste incineration, cremation). The ERT commends Luxembourg for this improvement and for attaching the report as an Appendix 4 to the IIR. However, it is recommended to integrate the results and explanations in the respective sectoral chapter (chapter 6) in next year's IIR.

122. The ERT noticed that the notation keys have not always been used properly. The ERT encourages Luxembourg to reconsider its choice of notation keys and adapt them accordingly (e.g. to “NE” where emissions are not estimated) and provide justifications for their use.

Completeness

123. Luxembourg submitted NFR tables for the years 1990-2014. However, a considerable number of sources were not estimated but reported as "NA" and "NO", although related activities do occur in Luxembourg. To avoid underestimations, the ERT recommends that Luxembourg estimates emissions for those sources where default EFs are available from the EMEP/EEA 2013 Guidebook and where relevant activity data can be obtained, e.g. from other reporting obligations.

124. The ERT notes that the inventory for waste is incomplete. Luxembourg has provided some emission data for Hg and POPs from 5.C.1.b, but no emissions are reported from 5.A solid waste disposal, 5.B biological treatment of waste and 5.D wastewater handling as well as for some gases of 5.C waste incineration. The ERT recommends that Luxembourg estimates emissions from the missing categories applying the methodologies of the EMEP/EEA 2013 Guidebook and reports on them in future submissions. Where emissions are not reported, the reasons for such exclusions should be clearly indicated in the IIR.

Consistency, including recalculation and time series

125. For the majority of categories Luxembourg has not reported emissions data. The ERT recommends that Luxembourg implements further improvements in reporting and provides consistent time series of emissions in future submissions.

Comparability

126. The ERT recommends that Luxembourg applies the methods provided in the EMEP/EEA 2013 Guidebook for the waste sector and provides completed NFR tables with a minimum use of notation keys.

Accuracy and uncertainties

127. The ERT encourages Luxembourg to undertake an uncertainty analysis for the current and future waste categories covered in order to support the improvement process and to provide an indication of the reliability of the inventory data.

128. The ERT encourages Luxembourg to implement sector specific QA/QC procedures and report on them in its future submissions.

Improvement

129. Compared to the previous Stage 3 review, an IIR was submitted and emission data for incineration of clinical waste and cremation were reported. The ERT commends Luxembourg for this improvement.

130. No category-specific improvement plans are described in the sectoral chapter of the IIR. During the review, however, the Party announced plans for improvement. The ERT commends Luxembourg for that, and recommends to include and maintain a section on planned improvements in the IIR and report on its implementation in future submissions.

Sub-sector Specific Recommendations

Category issue 1: 5.A Solid Waste Disposal – NMVOC, TSP, PM_{10}, $PM_{2.5}$

131. No emissions are reported under category 5.A solid waste disposal ("NA"). As already stated in the report from the previous Stage 3 review, NMVOC emissions could be calculated applying the NMVOC per m^3 landfill gas ratio of the EMEP/EEA 2013 Guidebook. In response to a question raised during the review, Luxembourg informed the ERT that using data from the GHG emission inventory would be considered for estimating PM and NMVOC emissions from this category in future. The ERT welcomes this plan and recommends that Luxembourg includes emissions from this category in future submissions.

Category issue 2: 5B Biological Treatment of waste, composting – NH_3

132. No emissions are reported for category 5.B.1 composting ('NA'), although emission factors are provided by the EMEP/EEA 2013 Guidebook. Under the UNFCCC, however, CH_4 and N_2O emissions from compost production are reported from 1993 onwards, so this activity is apparently occurring in Luxembourg. This was also confirmed during the previous Stage 3 review when Luxembourg explained that data on compost production was available. In response to a question, Luxembourg presented its plan to investigate relevant activity data and estimate NH_3 emissions. The ERT commends the Party for this plan and recommends that Luxembourg implements this improvement as soon as possible and reports emissions from this source in its next submission.

Category issue 3: 5C Waste incineration – all pollutants

133. In its NFR, Luxembourg reports emissions from 5.C.1.b.v cremation (Hg, POPs) for 1995-2014, and emissions from 5.C.1.b.iii clinical waste incineration (heavy metals, POPs) for 1990-1994. In Appendix 4 the reason for stopping clinical waste incineration is well described, as well as the reporting of emissions from cremation since 1995. For clinical waste incineration, however, no methodological description is provided. In response to a question by the ERT Luxembourg explained that POPs emissions were taken from a study conducted by the Environment Agency in the early 1990s, based on activity data from the operators. The ERT recommends that Luxembourg includes this information as well as a reference to the underlying literature (incl. emission factors used) in its next submission.

134. No emissions of main pollutants, particulate matter and heavy metals are reported for the covered waste incineration categories. The IIR does not contain any explanations regarding the use of notation key 'NE'. Cremation, for example, also

causes emissions of a number of other pollutants, not only POPs and Hg. In response to a question by the ERT, Luxembourg stated that it planned to estimate other pollutants for this category for future submissions. The ERT welcomes this plan and encourages the Party to improve completeness of reporting on a continuous basis.

135. Luxembourg does not report any emissions from 5.C.1.b.i industrial waste incineration, 5.C.1.b.ii hazardous waste incineration and 5.C.2 open burning of waste. During the review, Luxembourg explained that there are no industrial or hazardous waste incineration facilities in Luxembourg and that all this waste is exported for incineration. Open burning of waste is forbidden by law (Loi du 21 mars 2012 relative à la gestion des déchets). The ERT thanks Luxembourg for this explanation and recommends to include this information in the next IIR.

Category issue 4: 5D Wastewater handling – NMVOC, NH_3

136. No NMVOC emissions are reported under category 5.D wastewater handling ("NA"). In the report from the previous Stage 3 review Luxembourg had already been encouraged to estimate emissions from this source according to the methodology provided by the EMEP/EEA Guidebook. The Party explained that relevant activity data for NMVOC calculation (m3 of wastewater treated) was not available in Luxembourg, and that a change of notation keys from "NA" to "NE" was planned. The ERT recommends that Luxembourg continues its efforts to get relevant activity data and estimates emissions for future submissions. Data on treated wastewater are to be reported by all EU MS under the Urban Waste Water Treatment Directive (UWWTD), so the respective activity data should be available as a basis for calculation.

137. No NH_3 emissions from wastewater handling are reported, although the default emission factor from the EMEP/EEA 2013 Guidebook allows for a simple calculation of ammonia based on the number of inhabitants using latrines. The ERT recommends that Luxembourg investigates the occurrence of latrines in the country and considers estimating emissions from this source in future submissions.

Category issue 5: 5E Other waste

138. Luxembourg does not report emissions from other waste and does not provide an explanation for the use of the notation key "NE" in the IIR. The ERT encourages Luxembourg to investigate the occurrence of the activities covered under this category and reports on that in its next submission.

LIST OF ADDITIONAL MATERIALS PROVIDED BY LUXEMBOURG DURING THE REVIEW

1. No items requested